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CITY AND COUNTY OF SAN FRANCISCO**

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**SAN FRANCISCO  
WATER DEPARTMENT**

Ms. Palma Risler  
U.S. EPA, Region 9  
W-3-3  
75 Hawthorne Street  
San Francisco, CA 94105

March 11, 1994

Re: Comments to "Draft Regulatory Impact Assessment of the Proposed Water Quality Standards for the Bay/Delta and Critical Habitat for the Delta Smelt" Issued December 15, 1993.

Dear Ms. Risler:

On December 15, 1993, the Environmental Protection Agency (EPA) published a Draft Regulatory Impact Assessment (RIA) on proposed water quality standards for the San Francisco bay and Delta. Pursuant to Executive Order 12866, federal agencies must conduct RIA's in order to assess the regulatory impact of their actions. San Francisco welcomes this opportunity to provide the EPA with additional information on the potential impacts of the proposed Delta standards. It is our understanding that the EPA intends to continue working on the development of the RIA. Therefore the City's comments are offered in the spirit of cooperation in the effort to create a better data base upon which to base assessments of economic impacts resulting from the proposed regulatory actions.

As an initial comment, San Francisco was pleased to see that the EPA has recognized that it would be possible to mitigate adverse economic impacts (and we note that environmental impacts might also be mitigated) if the program of implementation allows for the provision of alternative supplies of water in-lieu of direct releases or forbearance of use by water users that would be hard hit by having to release water to the Delta. In an effort to bring rationality to the allocation of responsibility to meet Delta water needs, San Francisco has urged the development of a program of mitigation credits. This program would allow an entity to substitute a mitigation credit in-lieu of having to release water to the Delta. The credit could include water from an alternative source, the payment of money for environmental purposes, the undertaking of an environmentally beneficial project, and other programs which might be developed. A state agency would decide how credits would be applied against water obligations. This type of program would work for water users with reservoir storage and direct diverters, be they urban or agricultural users.

The following is a summary of San Francisco's comments. This summary is supported by two studies which are attached. These studies were commissioned by San Francisco to

analyze the RIA and to work with the EPA to develop a more comprehensive understanding of regional impacts of water shortages. The conclusion of these studies is that costs are substantially higher in the San Francisco region than in Southern California, which was the model used in the RIA. The economic impact of lost water to the San Francisco region is \$3,038 as compared to the EPA's estimate of \$1,740 AF. Water transfers cost \$390-\$465 AF in San Francisco as compared to the EPA estimates of \$175-\$250 per AF. The cost of reclamation in the San Francisco region is \$1,300 AF as compared to \$383 AF in the EPA study.

In conjunction with the promulgation of water quality standards for the Delta, the RIA has assumed that to assess the impact of the proposed regulation, all urban areas may be treated the same. Accordingly, EPA estimated the cost of urban water shortages in all areas based upon the cost of shortages estimated in Los Angeles. Similarly, EPA estimated the cost of reclamation as a replacement supply in all areas based upon the cost of reclamation in Southern California. Finally, EPA estimated the cost of water transfers to all urban areas based upon the cost of transfers to urban areas linked to the State Water Project (SWP).

San Francisco's review of the EPA's estimated costs indicates that costs based on the Southern California model increase significantly in the San Francisco water service area.<sup>1</sup> Included with these comments in Appendix A and B are reports issued by San Francisco's economic consultants. The results are summarized below.

San Francisco is in a different circumstance than Los Angeles for several reasons. Shortage costs are higher due to low base water use in the region. Costs of replacement alternatives, including reclamation and water transfers, are greater because of the physical constraints on the delivery and treatment of water in the region, the higher population density and income levels, smaller lot sizes, and milder climate than in Southern California.

San Francisco also has a number of concerns with the RIA that are not addressed in this submittal. The City urges the EPA to address these concerns during the course of development of the final RIA:

1. The water supply impact of the standards may be larger than estimated by EPA in the RIA.

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<sup>1</sup> San Francisco serves water to approximately 2.3 million customers in the counties of Alameda, Santa Clara, and San Mateo on a wholesale basis and at retail in San Francisco. The Silicon Valley is within the service area. The Tuolumne River provides 85% of the demand in the service area. Local sources supply the remainder. Demands not met by San Francisco are filled by individual customer agencies which have links to either the State Water Project, Santa Clara Valley Water District or local groundwater.

2. The water supply impacts may be allocated differently to urban areas than assumed by EPA.
3. Water transfers from the Central Valley may not materialize as suggested by EPA.
4. The economic analysis in the RIA is static and does not distinguish short run and long run impacts.

#### Cost of Shortages

Three variables raise the cost of shortages in urban areas: 1) large base shortages; 2) low per capita water use; and 3) high water prices. The less water that is used (on average or during shortages) the greater the value at the margin and the more it costs to decrease usage. Therefore, cities with relatively large base shortages during droughts have a high marginal value of water at such times and the cost of these shortages will be large during future droughts (variable 1). Further, the marginal value of water tends to be high on average in cities with low per capita water use, again increasing cost (variable 2). Finally, cities with high priced water will cut back low value water use and have a high value of water at the margin, again increasing cost (variable 3).

During times of water shortage, the base shortage experienced in San Francisco exceeded those assumed by the EPA. The EPA estimated shortages averaging 15% of water demand during critical years while in the San Francisco service area the shortage averaged between 22% and 24%. During the 1986-92 drought, water consumption in San Francisco fell 26% and in the wholesale service area by 23%. In contrast, water use in Los Angeles fell 19%.

Per capita water use in San Francisco is the lowest in state for any large urban area. Before the drought, San Francisco averaged 130 gallons per capita per day (gcd) to all users and 70gcd to residential users. In the wholesale service area, water use averaged 179gcd to all users and 113gcd to residential users. In 1992, water use in San Francisco averaged 96gcd to all users and only 53gcd to residential users. In the wholesale service area the average fell to 130gcd for all users and 78gcd to residential users. By contrast, EPA estimated the cost of water shortages based upon water practices in Los Angeles, where after the drought water usage was 145gcd.

The price of water is higher than assumed by EPA in the shortage cost analysis. Water and sewer retail prices in San Francisco are among the highest in the state. The combined price for water and sewer service in San Francisco was \$3.86 per billing unit in 1991. The price of water charged by other cities in the service area is currently \$1.99 per billing unit. EPA, using the case study from Los Angeles, used a price of water and sewer service in Los Angeles of \$1.71.

The Los Angeles study was an extrapolation of demonstrated, short-term consumer responses to water price changes. There are several important flaws in both the theoretical foundation of the methodology and its implementation. For example, weather, income and lot sizes were all ignored. San Francisco has provided a more acceptable and better documented methodology in its recommendations contained in Appendix B.

Based upon the study by Griffith and Associates (DMG) of consumers' reaction in 1991 to water price increases, the EPA has estimated a welfare loss (cost of shortage) at approximately \$1,600 during a critically dry year. At EPA's request, San Francisco used the same study, despite its flaws, to estimate the shortage cost in its service area. The DMG study did not report an estimate of welfare losses associated with any particular level of water conservation. However, using a straight line demand function, a welfare loss may be computed based on any conservation goal. A comparison of the DMG loss estimates and San Francisco's loss estimates is shown below.

Comparison of Estimated Welfare Losses

<u>Shortage Percentage</u>	<u>DMG Study Single Family<sup>2</sup></u>	<u>SF Study</u>	
		<u>Single Family</u>	<u>Multi-Family</u>
5%	\$ 964.00	\$1,753.00	\$ 4,137.00
10%	\$1,350.00	\$2,396.00	\$ 7,139.00
15%	\$1,740.00	\$3,038.00	\$10,140.00

The \$1,600 welfare loss did not precisely correspond to any of the three levels of water shortage, but rather occurs between the 10% and 15% ranges. San Francisco's higher population density, higher income, smaller lot size and milder climate than found in Southern California tend to make San Francisco's water use relatively more stable and correspondingly less price sensitive. This lower sensitivity translates into a proportionally higher welfare loss during a drought. As the table above demonstrates, costs are considerably higher in San Francisco. San Francisco also analyzed the cost in terms of rate increases which would be required in order to achieve the percent shortage desired. The following shows the price per 100 cubic feet needed to achieve the level of conservation.

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<sup>2</sup> The DMG study did not analyze multi-family housing. In San Francisco multi-family housing accounts for approximately 50% of water use.

Estimated San Francisco Market Clearing Price

(2 month billing units)

<u>Percent Shortage</u>	<u>Market Clearing Price, Per 100 cubic feet</u>	
	<u>Single Family</u>	<u>Multiple Family</u>
5%	\$ 5.50	\$16.39
10%	\$ 8.45	\$30.17
15%	\$11.40	\$43.95

The costs reflected above are approximately 75% greater than those indicated in the Los Angeles study. DMG reported that for multi-family customers, Los Angeles actually increased their usage despite a substantial price increase. In San Francisco there was a small decline in usage. The differences could be explained by regional characteristics such as rain fall or lot size. That was not reflected in the study.

Water Transfers

In order to ameliorate a portion of the impact of the water lost to Delta outflow, the EPA has assumed that water transfers would be available. EPA reviewed the State Drought Water Bank and concluded that all urban areas may obtain water transfers from Central Valley farmers at a cost of between \$175 and \$250. EPA has assumed costs based upon those incurred by SWP contractors and has assumed availability of pumping capacity in order to move necessary amounts of water. In San Francisco's case neither assumption is necessary valid.

San Francisco is not a SWP contractor and therefore its costs for transportation alone are higher than the cost for SWP contractors. Further, access to the SWP pumps for water transfers is very limited due to regulatory constraints. Further, there is an issue as to the priority accorded non-project water which may be conveyed to SWP contractors on non-contractors.

During the drought, San Francisco purchased 107,848 acre feet of water from the Drought Water Bank and other sources. The full purchase cost of water delivered to the service area averaged approximately \$282 per acre foot, well above the maximum purchase cost assumed in the RIA. The average cost is based upon purchases ranging from \$42-175/AF. The transportation costs may well increase in the future, further increasing the delivery costs. In

addition, San Francisco had to construct turnouts and additional transportation facilities which added \$24 per acre foot onto the cost. Further, treatment costs for the additional water were \$77 per acre foot and administrative fees and expenses added an additional \$8 per acre foot. The full cost of water purchased and delivered to San Francisco customers was \$390 per acre foot. To equate these costs to the range of costs assumed by the EPA brings the cost of transferring water to San Francisco to a range of \$390-\$465. This is substantially in excess of the maximum cost of \$250 per acre foot assumed by the EPA.

### Reclamation

In addition to water transfers, EPA assumes that reclamation will be available to make up for further losses in water supply. EPA estimates the cost of water at \$705 per acre foot based upon the cost of "marginal" reclamation projects in Southern California. EPA estimated that the net cost of reclamation was \$383 after deducting the transportation cost of "traditional" Delta water supplies.

The cost of reclaimed water is substantially higher in San Francisco than in Southern California due to higher costs for treatment of reclaimed water, transportation and storage. The net cost is also higher since San Francisco incurs only a small expense to transport its traditional water supply.

In order to reclaim sewage, it must be thoroughly treated and cleaned, transported to areas of use and at times stored prior to use. In Southern California, reclaimed water has historically been discharged into nearby rivers after relatively high levels of treatment. Little additional treatment is normally required prior to use. In San Francisco, a much higher level of treatment will be required thereby increasing expenses since the reclaimed water will not be stored in a ground water aquifer, but rather used directly for either consumptive or non-consumptive purposes.

Also distinguishing the San Francisco situation from Southern California is that in the San Francisco area sewage treatment plants are typically located near the Bay or ocean and downhill from populated areas. Transmission facilities will have to be built in existing areas where pipeline construction is expensive. In Southern California, sewage treatment plants are often located inland from the ocean and uphill from populated areas which serves to keep costs lower.

Water in the San Francisco region is generally stored in surface reservoirs. Aquifer storage is less common and generally devoted to potable water. Storage of reclaimed water in the San Francisco region will be relatively expensive as compared to Southern California where water is generally stored in ground water aquifers.

San Francisco conducted a survey of 11 projects proposed in the region with a total

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reclamation potential of 134,536 acre feet per year of capacity. The average cost of reclaimed water from these projects is \$1,372 per acre foot. By contrast, EPA considered 15 reclamation projects in Southern California with a total of 61,000 acre feet of capacity. The average cost from those projects was \$705 per acre foot. In comparison, the net cost of reclamation as a replacement for Tuolumne River water is estimated to be over \$1,300 per acre foot compared to EPA's estimate of net cost for urban reclamation at \$383 per acre foot.

Thank you very much for this opportunity to comment on the RIA. We look forward to working with you on the development of the final RIA.

Very truly yours,



ANSON B. MORAN  
General Manager  
Public Utilities Commission

**Review of the "Draft Regulatory Impact Assessment  
of the Proposed Water Quality Standards for the San Francisco Bay/Delta  
and Critical Habitat Requirements for the Delta Smelt"**

Prepared for

**The San Francisco Public Utilities Commission**

by

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San Francisco California

March 9, 1994

**Review of the "Draft Regulatory Impact Assessment  
of the Proposed Water Quality Standards for the San Francisco Bay/Delta  
and Critical Habitat Requirements for the Delta Smelt"**

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**Review of the "Draft Regulatory Impact Assessment  
of the Proposed Water Quality Standards for the San Francisco Bay/Delta  
and Critical Habitat Requirements for the Delta Smelt"**

**I. Introduction**

EPA has proposed water quality standards for the Delta that would cause water shortages and impose costs on many urban areas. The EPA assessment of these costs, in a Regulatory Impact Assessment (RIA), is based upon one fundamental assumption about urban areas--namely that for the purposes of cost estimation all urban areas can be treated the same. Accordingly, EPA estimated the cost of urban water shortages in all areas based upon the cost of shortages estimated in Los Angeles. Similarly, EPA estimated the cost of reclamation as a replacement supply in all areas based upon the cost of reclamation in Southern California. Finally, EPA estimated the cost of water transfers to all urban areas based upon the cost of transfers to urban areas linked to the State Water Project. Based upon these assumptions, EPA set the net cost of reclaimed water to all urban users at \$383/af, the cost of water transfers to all users at \$175-\$250/af and the cost of shortages at \$1,612/af.

This report presents information about San Francisco water use practices which suggest that the proposed Delta water quality standards will impose substantially higher costs to that region than elsewhere. Shortage costs will be higher largely due to low base water use in the region. The cost of replacement alternatives, including reclamation and water transfers, will be higher because of the way water is delivered and treated in the region.<sup>1</sup>

The high cost of shortages and replacement alternatives makes San Francisco particularly vulnerable to the economic impact of Federal actions which restrict supplies to the region. The cost of finding replacement water is estimated to be at least twice the cost assumed by EPA for other urban areas. If the Federal actions incidentally restrict additional water transfers from occurring, as many now believe to be the case, the cost to San Francisco is estimated to be over three times the cost assumed by the EPA for other areas.

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San Francisco also has a number of basic concerns with the RIA which are not addressed in this report:

1. The water supply impact of the standards may be larger than that estimated by EPA in the RIA.
2. The water supply impacts may be allocated differently to urban areas than assumed by EPA.
3. Water transfers from the Central Valley may not materialize as suggested by EPA.
4. The economic analysis in the RIA is static and does not distinguish short run and long run impacts. The City urges that EPA address these concerns in the final RIA.

## **II. Analysis**

### **Water Shortages**

#### **Discussion**

EPA estimated the cost of shortages, based upon an analysis of water use in Los Angeles. The cost of shortages in San Francisco may be higher than estimated by EPA, because San Francisco has larger base water shortages, lower per capita water use and higher water prices than assumed by EPA in its shortage cost analysis.

Following is a general discussion of the impact of these variables upon shortage costs. A comparison is then made between these variables in San Francisco and those used by EPA to estimate shortage costs.

#### **Variables that Affect the Cost of Shortages**

Three variables raise the cost of shortages in urban areas:

1. Large base shortages;
2. Low per capita water use;
3. High water prices.

The impact of these variables is explained by the observation that the less water is used (on average or during shortages) the more it is worth at the margin and the more it costs to decrease use. This observation suggests that cities with relatively large base shortages during droughts have a high marginal value of water at such times.

Therefore additional shortages in these cities will be particularly costly during future droughts (variable 1). The observation also suggests that the marginal value of water tends to be high on average in cities with a low per capita water use. Therefore, shortages in such cities will also tend on average to be particularly costly (variable 2). Finally, the observation suggests that cities with high priced water will cut back low value water use and have a high value of water at the margin. Shortages should be costly in these cities as well (variable 3).

A comparison of base shortages, per capita water use and water prices in San Francisco and shortages, per capita use and prices assumed by EPA in its analysis of shortage cost, suggests that shortage costs in San Francisco will be higher than those estimated by EPA.

#### **Base Shortages**

Base shortages experienced in San Francisco exceed those assumed by the EPA. EPA assumed base shortages averaging 15% of water demand during critical years (where critical year is defined by rainfall during the 11 driest years on record). Base shortages during critical years in the San Francisco system are expected to average

between 22% and 24% of system demand.

Table 1 illustrates water demand and supply for the San Francisco water system. Current water demand is 305,000 acre feet per year (afa). Current system yield varies, between 271,000 afa and 244,000 afa, depending upon impending deliberations concerning water allocations on the Tuolumne River. System yield may be 271,000 afa, if those deliberations are resolved favorably (High Yield). System yield may be 244,000 afa (or perhaps less), if the deliberations are not resolved favorably (Low Yield).

A water supply analysis was done which indicated that the San Francisco system can be operated to avoid shortages in all but 11% to 17% of the driest years, depending upon the yield assumption (Table 1). During those critically dry years, system shortages are expected to average between 22% and 24% of system demand (Table 1). Demand for San Francisco water is expected to increase 6% between 1995 and 2010. The increase in demand suggests that critical year base shortages could average close to between 28% and 30% of system demand in 2010.

The 1986 - 1992 drought illustrates the impact of base shortages upon San Francisco water customers. During that six year drought period, water consumption in the City of San Francisco fell 26% and water consumption among wholesale customers fell 23%. In contrast, water use in Los Angeles fell 19% during the drought (Table 2).

#### Per Capita Water Use

Per capita water use is lower in San Francisco and its service area than was assumed in the EPA analysis of shortage costs. In 1986 water use in San Francisco averaged 130 gallons per capita per day (gcd) to all users and only 70 gcd to residential users (Table 2). Water use of wholesale customers in the service area averaged 179 gcd to all users and 113 gcd to residential users.

San Francisco per capita water use declined dramatically during the last drought. In 1992, water use in San Francisco averaged 96 gcd to all users and only 53 gcd to residential users. Water use in the San Francisco service area averaged 137 gcd to all users and 78 gcd to residential users.

By contrast, EPA estimated the cost of water shortages based upon an analysis of water use practices in Los Angeles. However, water use in Los Angeles after the drought was 145 gcd, well above water use in San Francisco and its service area (Table 1).

**Table 1. Base Water Shortages to San Francisco Water System**

<b>Year 1995</b>	<b>High Yield Assumption</b>		<b>Low Yield Assumption</b>	
	<b>Quantity (afa)</b>	<b>Proportion (%)</b>	<b>Quantity (afa)</b>	<b>Proportion (%)</b>
<b>System Demand</b>	<b>305,000</b>		<b>305,000</b>	
<b>System Yield</b>	<b>271,000</b>		<b>244,000</b>	
<b>Years Shortage</b>	<b>8</b>	<b>11%</b>	<b>12</b>	<b>17%</b>
<b>Average Shortage</b>	<b>67,000</b>	<b>22%</b>	<b>74,000</b>	<b>24%</b>
<b>Maximum Shortage</b>	<b>92,000</b>	<b>30%</b>	<b>122,000</b>	<b>40%</b>

**Source: Initial Comments of the City and County of San Francisco on the Draft  
Environmental Assessment for the New Don Pedro Project  
January 1994. Exhibit T.**

Table 2. San Francisco and Los Angeles Per Capita Water Use

		1986	1992
City of San Francisco			
Gross	(gcd)	130	96
Residential	(gcd)	70	53
Wholesale Customers			
Gross	(gcd)	179	137
Residential	(gcd)	113	78
Los Angeles			
Gross	(gcd)	179	145
Residential	(gcd)	115	

Source: Initial Comments of the City and County of San Francisco on the Draft Environmental Assessment for the New Don Pedro Project. Exhibit T.

City of Los Angeles Water Conservation Reports.  
Urban Water Management Plan. City of Los Angeles, Department of Water and Power

### The Price of Water

The price of water in San Francisco is higher than was assumed in the EPA shortage cost analysis. Water and sewer retail prices in San Francisco are among the highest in the State. The combined price of water and sewer service in San Francisco was \$3.86 per billing unit (for water use over six units) in 1991. The price of water charged by other cities in the service area is currently \$1.99 per billing unit.

EPA estimated the cost of shortages from a case study of Los Angeles water use. However, the price of water and sewer service in Los Angeles was \$1.71 per unit in 1991, at the time of that study (Table 3). (In 1993, Los Angeles raised its highest water rate to a level comparable to that in San Francisco) .

### The Cost of Shortages in San Francisco

The low per capita water use, the high base shortages and the high water prices all suggest that San Francisco and its service area will face relatively high costs from additional shortages resulting from EPA Delta standards. San Francisco is undertaking a study to try to measure shortage costs in the area in more detail. The results of this study should help EPA to more accurately estimate urban shortage costs in the State.

## **B. Water Transfers**

### Discussion

The history of the State Drought Water Bank convinced EPA analysts that all urban areas can obtain water transfers from Central Valley farmers for about \$225 per acre foot. San Francisco's experience with the Drought Water Bank in 1991-1993 indicates that urban areas not linked to the State and Federal water projects must pay almost twice that amount for water transfers. In addition, San Francisco believes that the Federal standards may substantially reduce the ability to obtain water transfers through the Delta at any price, particularly for water users that are not part of the State or Federal water projects and for water obtained by project contractors outside of their entitlement, i.e., non project water. That would increase the cost of water shortages, due to the EPA standards, well above the cost estimated in this report.

### Variables that Affect the Cost of Transfers

The cost of water transfers to urban areas is a function of the full purchase cost, the cost of transport and the cost of treatment. EPA assumed that the purchase cost of transfers would be between \$175 and \$250 per acre foot and that there would be no additional costs to transport or to treat water. San Francisco's experience with transfers during the drought suggests that the cost to purchase, transport and treat water obtained from transfers will all be higher than assumed by the EPA.

**Table 3. Price Per Billing Unit of Water and Sewer in San Francisco and Los Angeles**

	<b>San Francisco</b>	<b>Los Angeles</b>
<b>Year</b>		
<b>1990</b>	<b>\$3.17</b>	<b>\$1.63</b>
<b>1991</b>	<b>\$3.86</b>	<b>\$1.71</b>

Prices shown are for the highest block rate.

Prices in Los Angeles were increased in late 1992 to about \$4.00/af for consumption over 28 billing units.

Source: San Francisco Water Department and the Los Angeles Department of Water and Power

#### Full Purchase Cost

The full purchase cost of water was increased because San Francisco in effect bought more water than it could use during the drought. This occurred because the timing of transfers and limits on the capacity of the City's facilities to accept and utilize deliveries. San Francisco purchased a total of 107,848 acre feet of water from the Drought Water Bank and other sources between 1990 - 1992. Of that total, only 77,933 acre feet of water was delivered to the service area when it could be used. The full purchase cost of the water delivered to the service area averaged \$282 per acre feet, well above the maximum purchase cost assumed by EPA (Table 4).

#### Connection and Facility Costs

San Francisco does not have a direct connection with the project facilities that were used to transport most of the water transferred during the drought. To obtain water from transfers, San Francisco had to build turn outs and transportation facilities which added an additional \$24 per acre foot of water transferred during the drought. By contrast, EPA assumed no cost to transport water.

#### Treatment and Pumping Cost

San Francisco normally delivers high quality Sierra water to its customers, which requires only minimal water treatment. Water purchased by the City during the drought was of lower quality and required additional treatment. The cost of the additional necessary water treatment was \$77 per acre foot. EPA assumed that there would be no additional cost to treat water.

#### The Cost of Transfers in San Francisco

Including administrative fees, (\$8 per acre foot) the full cost of water purchased by and delivered to San Francisco customers during the drought was \$390 per acre foot. EPA assumed that transfers would cost no more than \$250 per acre foot. This strongly suggests that future water transfers to the San Francisco service area will cost more than EPA estimated in the RIA.

### C. Reclamation

#### Discussion

EPA estimated that the cost of reclamation to replace water given up to support the Delta standards was \$705 per acre foot. EPA based this estimate upon the cost of "marginal" reclamation projects in Southern California described in a regional survey of Southern California reclamation projects (California Association of Reclamation Entities of Water, 1989). EPA estimated that the net cost of reclamation was \$383, after deducting the transport cost of "traditional" Delta water supplies.

Table 4. San Francisco Water Transfers During the 1987 -1992 Drought

Year	Quantity Purchase (af)	Net Delivered (af)	Net Cost (\$/af)	Purchase Cost (\$/af)	Treatmen Cost (\$/af)	Conection Cost (\$/af)	Admin. Cost (\$/af)	Total Cost (\$/af)
1990	7,492	7,492						
1990	4,891	4,891						
1991	50,000	33,000						
1991	19,470	13,550						
1992	19,000	19,000						
Totals	100,853	77,933	\$22,010,059	\$282	\$77	\$24	\$8	\$392

Source: San Francisco Water Department

The cost of reclamation appears to be higher in the San Francisco service area than in Southern California, due to higher costs for reclamation treatment, transportation and storage. The net cost of reclamation is also higher, since San Francisco pays only a nominal cost to transport its traditional water supply. Following is a general discussion of the impact of these variables upon reclamation costs in San Francisco and a survey indicating the cost of reclamation in the region.

#### Variables Affecting the Cost of Reclamation

The cost of reclamation includes the costs of treatment, transportation and storage required to obtain and use reclaimed water. In order to reclaim sewage, it must be thoroughly treated and cleaned, it must be transported to areas where it can be used and, at times, it must be stored prior to use.

##### Treatment Costs

Sewage in the San Francisco region has historically been discharged into the San Francisco Bay after only moderate amounts of treatment. In order to reclaim water in the service area, a much higher level of "tertiary" treatment is normally required. Sewage in Southern California has historically often been discharged directly into nearby rivers after relatively high levels of treatment. In order to reclaim water, little additional treatment is normally required by agencies in Southern California.

##### Transport Costs

Sewage treatment plants in San Francisco are typically located next to the Bay and downhill from most populated areas. To transport water from treatment plants, where it is reclaimed, to populated areas, where it is used, expensive pipeline construction is often required. Sewage treatment plants in Southern California are often located inland from the ocean and uphill from populated areas. Reclaimed water in that region is more easily transported to populated areas, downhill and along natural water courses.

##### Storage Costs

Water in the San Francisco area is generally stored in surface reservoirs; aquifer storage is less common. This practice means that storage of reclaimed water in San Francisco will be relatively expensive. Water in Southern California is widely stored in extensive groundwater aquifers. Reclaimed water is often inexpensively stored in these aquifers.

#### The Costs of Reclaimed Water in San Francisco

The location of sewage treatment plants, historical treatment practices and problems with storage suggest that reclamation in the San Francisco Service Area will cost more than reclamation in Southern California.

Table 5. Survey of Reclaimed Water Projects and Opportunities in the San Francisco Service Area

Agency (1)	Project	Size (afa)	Cost (2) (\$/af)
1 City and County of San Francisco	Master Plan	21,000	\$1,420
2 City of Gilroy *	Reclaimed Water	3,000	\$240
3 City of Mountain View *	Shoreline, blended water	505	\$505
4 City of Pacifica	Plant Improvements	2,000	\$1,588
5 City of Palo Alto	PARWQCP Master Plan	4,200	\$810
6 City of Redwood City	Reclaimed utilization	4,480	\$1,859
7 City of San Jose	Non-potable	37,000	\$1,250
8 Santa Clara Water District	Groundwater recharge	20,000	\$1,700
9 City of Sunnyvale	Reclamation Program	2,240	\$550
10 Zone 7 Alameda County	Groundwater Recharge	36,080	\$1,456
11 Union Sanitary Dist	Non-potable Reuse	4,031	\$1,220
<b>Totals</b>		<b>134,536</b>	<b>\$1,372</b>

Source: February 1994 Task Force Member Agencies Survey,  
San Francisco Water Department, Santa Clara Water District  
and the Los Angeles Department of Water and Power.

(1) The Gilroy and the Mountain View projects include extensions to existing projects.

(2) A 7% discount rate and 20 year project life was assumed to estimate the cost of these projects.

San Francisco conducted a phone survey to determine the cost of reclamation projects planned or conceived in its service area. The survey included eleven projects proposed for the region, including a total of 134,536 acre feet per year of capacity. The average cost of reclaimed water from these projects is \$1,372 per acre foot (Table 5). By contrast, EPA considered fifteen reclamation projects from Southern California, including a total of 61,000 afa of capacity. The average cost of water from those projects was \$705 per acre foot.<sup>2</sup>

San Francisco pays only a nominal cost to transport Tuolumne River water to the region. Therefore the net cost of reclamation, as a replacement for Tuolumne River water, is estimated to be over \$1,300 per acre foot. By contrast, EPA estimated that the net cost of urban reclamation was \$383 per acre foot, after deducting \$322 per acre foot as the cost to transport water from the Delta.

### III. Conclusion

EPA assumed that all urban agencies could be treated as a single entity for purposes of estimating the cost of the proposed Delta standards. This fundamental assumption helped to simplify the analysis of urban costs, but it led EPA to underestimate the costs of the Delta standards to the San Francisco region. San Francisco has different water use practices than other urban areas. Water use is lower in San Francisco than in Los Angeles. Base shortages and water prices have tended to be higher. This suggests that the cost of shortages in San Francisco will be higher than estimated by EPA.

Similarly, water treatment plants in the San Francisco service area are generally located closer to the ocean (bay) than treatment plants in Southern California, and downhill from population centers. This suggests that reclamation in San Francisco will tend to cost more than reclamation in Southern California. Our survey of reclamation projects in the San Francisco service area backs up this conclusion. That survey indicates that San Francisco's reclamation will cost well over \$1,300 per acre foot, compared to the cost of Southern California reclamation, estimated to be \$383 per acre foot in the RIA.

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There is a widely divergent view about the future of reclamation in the San Francisco service area. Some engineers that work on reclamation projects in the area believe costs will remain high. Bahman Sheikh, who helps plan reclamation projects for the Los Angeles Department of Water and Power, believes that costs will fall as people become more familiar with reclamation. Bahman Sheikh believes that reclamation in the San Francisco service area will typically cost about \$1,000 per acre foot, not the \$705 estimated by the EPA.

Finally, San Francisco water supplies are delivered directly from the Sierra, unlike Southern California water supplies which are delivered via the Delta and the State Water Project. While providing high quality water to San Francisco water, this system also entails high cost water transfers. A review of San Francisco's water purchases during the drought makes this point clearly. That review indicates that San Francisco spent almost \$400 per acre foot for water transfers, compared to the \$225 average cost estimated by EPA.

This leaves San Francisco particularly vulnerable, from an economic perspective, to water supply changes resulting from the Federal Delta actions. At best, the cost of finding replacement water in San Francisco is estimated in this report to be almost twice the cost assumed by EPA for other urban areas. If the Federal actions restrict water transfers, the cost to San Francisco is estimated to be over three times the cost assumed by the EPA for other areas.

**COMMENTS ON ECONOMIC ANALYSIS OF WATER COST**

*Contained in:*

**Draft  
Regulatory Impact Assessment of the  
Proposed Water Quality Standards  
for the San Francisco Bay/Delta  
and Critical Habitat  
Requirements for the Delta Smelt**

*Submitted to:*

**City and County of San Francisco  
Public Utilities Commission**

*Submitted by:*

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**March 9, 1994**

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## Summary

On December 15th 1993 the Environmental Protection Agency (EPA) published a draft regulatory assessment on proposed water quality standards for the San Francisco Bay and Delta. In that report, the EPA used a \$1,600 per acre foot estimate for California's residential customer welfare loss due to a water shortage in a critical dry year. This estimate, however, was based only upon a Los Angeles study. By applying the study's methodology to San Francisco, the comparable welfare loss would be \$3,000.

These results compare reasonably and intuitively. There are several reasons to expect a substantially higher welfare loss in San Francisco. San Francisco generally has a higher population density and income levels, and smaller lot sizes. Any one or all of these three would be expected to lower the discretionary water use or increase customer willingness to pay for water.

The Los Angeles study, as well as its San Francisco counterpart, was an extrapolation of demonstrated, short-term consumer responses to water price changes. For example, if consumers decreased water consumption by 5% in response to a 100% price increase, then this method would predict that a 10% decrease in water consumption would be achieved by a 200% price increase.

There are several important flaws in both the theoretical foundation of the methodology and its implementation. For instance, weather, income and lot sizes are all ignored. These and other limitations are detailed and discussed in the Appendix. A more acceptable and better documented method is noted in the recommendations.

## **Review of Blue Ribbon study Results and its Implications**

The Draft Regulatory Assessment of the Proposed Water Quality Standards for the San Francisco Bay/Delta was published on December 15, 1993. The report contains a value of \$1,600 as the welfare loss per acre feet due to water shortages during a critically dry year. This welfare loss estimate was reportedly derived by Dr. Michael Hanemann of the University of California based on information obtained from a study done by Griffith and Associates (DMG) of consumers' reaction in 1991 to water price increases. A review of the Griffith and Associates' report published June 24, 1992 raised a number of concerns about the study's methodology and the data used to develop EPA's estimate of welfare loss.

### Summary of Methodology

The DMG's study was prepared by the Los Angeles Department of Water and Power (LADWP) and its focus was to estimate water rates that would balance water demand and supply during shortage periods. This is a "market clearing price". The study's methodology was as follows:

1. Randomly select a sample of customers that paid a penalty (in 1991) for exceeding their conservation objective. (Although 5,000 was the number discussed in the report, only 3,000 were listed in the results.)
2. Segment the customers into customer classes and then by usage levels within each class.

3. Using water consumption levels and water prices at two points in time (September 1990 and September 1991), estimate a straight line demand function for each customer class.
4. Using the straight line demand function, calculate a market clearing price necessary to achieve a 5%, 10% and 15% level of water conservation (or demand decrease).

The DMG study did not report an estimate of welfare loss associated with any particular level of water conservation. However, given the straight line demand function used in their study, any conservation goal and associated welfare loss can be computed. A summary of the DMG loss estimates is shown in Table 1 below:

**Table 1: Estimated DMG Welfare Losses**

<b>Percent Shortage</b>	<b>Welfare Loss</b>
5%	\$964
10%	\$1350
15%	\$1740

As can be seen from Table 1, the \$1,600 number did not exactly correspond to any of the three levels of water shortage. Rather, \$1,600 is "in the middle" between the 10 to 15 percent shortages.

The primary advantage of the DMG method is that it is simple. All welfare loss computations, whether from a 1% or 100% shortage, are computed from the same data and in the same way. The DMG method also requires only water price and consumption data, both of which are generally directly available from a water agency. The disadvantages, of which there are many, are listed in the appendix.

## Economic analysis of San Francisco Water Costs

Because of the significant differences between San Francisco and Los Angeles, it is expected that water use patterns and welfare losses would vary considerably during a drought. Specifically, San Francisco has a higher population density, higher income, smaller average lot size and milder climate than Los Angeles. Each of these factors would tend to make San Francisco water use relatively more stable and correspondingly less price sensitive. This lower sensitivity will directly translate into a proportionately higher welfare loss during a drought.

This section describes MHB's efforts to test and quantify these regional differences. Our intention was to provide a basis for regional comparison, not to improve upon the Los Angeles study. MHB has attempted to replicate the DMG methodology as close as possible; and the analytical technique should be considered the same for all practical purposes. MHB made only small changes, which were considered necessary to maintain the data integrity. These changes are listed below:

1. Because of time limitation, a smaller sample of 1,000 customers was used in San Francisco (compared to 3,000 for DMG). Because the sample sizes are already so large, this change should have no effect upon the study results.
2. MHB used only recorded price data. DMG originally used this approach but was later required to substitute a (politically defined) uniform price. The DMG substitution raised or lowered their welfare loss estimate in direct proportion to the difference in the prices.
3. MHB used a two-year period, 1989 to 1991 (compared to the one-year, 1990 to 1991 period used by DMG). This substitution was considered necessary because of the emphasis to capture the *first "full" reactions to the rationing penalties*

(DMG quotes). San Francisco started its rationing and penalties in mid-1990. The effect of this change is uncertain but probably not large.

### Study Results

The results of the MHB analysis for single family water customers are shown in Table 2. These results are presented in two ways, both for 2-month billing units. The first result is the welfare loss (in dollars per acre foot) as a function of the percent water shortage. As expected, San Francisco welfare losses far exceed that of Los Angeles, by approximately 75%. Both studies show a substantially increasing welfare loss as the percent shortage rises. For instance, the clearing price and welfare loss for a 15% shortage is nearly double that for a 5% shortage. On a comparable basis to the "\$1600 " welfare loss generally reported for Los Angeles, the San Francisco welfare loss would be \$2800.

**Table 2: Estimated San Francisco Welfare Losses**

<b>2-month billing units</b>		
<b>Percent Shortage</b>	<b>Welfare Loss</b>	<b>Market Clearing Price</b>
<b><u>Single Family Users</u></b>	<b>\$ per acre foot</b>	<b>\$ per hcf</b>
5%	\$1753	\$ 5.50
10%	\$2396	\$ 8.45
15%	\$3038	\$11.40

The second set of results is the market clearing price in dollars per hundred cubic feet (\$ per hcf); presented as a function of the percent water shortage. This is the price that customers would see on their bills. Many policy makers are therefore more concerned by the prices necessary to achieve conservation because it reflects the economic hardship that could be faced by residential consumers. The San Francisco results are also about 75% higher than the results from the LA study.

Most multi-family water users do not get a water bill. It is therefore expected that they would be relatively insensitive to water rates and water prices. This theory was directly stated in the DMG report and is born out by the data for both the Los Angeles and San Francisco studies.

DMG reported that multi-family customers *in Los Angeles actually increased their usage despite a substantial price increase*. The San Francisco customers in contrast had a small decline in usage. The difference could be explained by either *bona fide* regional characteristics such as rainfall or by lot size. In addition, the somewhat longer duration of the San Francisco study might have partially corrected for weather changes.

**Table 3: Estimated San Francisco Welfare Losses**

2-month billing units		
Percent Shortage	Welfare Loss	Market Clearing Price
<u>Multi Family Users</u>	\$ per acre foot	\$ per hcf
5%	\$ 4137	\$16.39
10%	\$ 7139	\$30.17
15%	\$10140	\$43.95

The San Francisco results are shown on Table 3. The clearing price for multi-family customers is more than double that of the single family group. In the case of a 15% shortage, the estimated market clearing price is \$43.95 per hcf with a corresponding welfare loss of \$10,140 per acre foot.

## Recommendations

The DMG study is simple and provides a reasonable welfare loss estimate. We should not, however, fool ourselves into thinking that the analysis is good. It is not. Even a slight variation in the data, assumptions or time interval could yield vastly different results. This is highlighted by the fact that DMG could provide no estimate at all for the multi-family market clearing price. In San Francisco this group represents about half of the residential water use.

### An Alternative Example

If water policy is to be effectively decided, the welfare loss and marketing clearing price calculation should be improved. As noted earlier, there are much better means of measuring the consumer responses to price changes. One that is commonly used and very well researched is called a "Shutsky-Shultz" (S-S) estimation. The key features of the S-S method are:

1. A sample of households is selected randomly from *all* residential customer segments.
2. *Five* years of water use data and price data is obtained for each household; plus a measure to relate the *income* levels among the different households.
3. For each customer segment, a *statistical estimation* relates water use to income and price.

This S-S method is statistically more valid than the DMG technique, since there is no sampling bias. Income is explicitly included as well as lot size, which would define one of the customer segments. By using five years of data, weather bias is also effectively minimized.

## **Appendix**

### **Critique of Blue Ribbon Methodology**

While the methodology used in the EPA study to estimate welfare loss during a shortage period can be commended for its simplicity, one must note however, that the methodology is conceptually weak and its implementation flawed.

1. Consumer responses to price change is not a new subject. There are a number of well established methods for developing consumer demand functions (both short term and long term) that are well documented. These methods have the potential to be both more "revealing" about what motivates water use changes, as well as more accurate.
  
2. The DMG study used the change in consumption between only two time periods to estimate consumer demand function. This is a "straight line" or linear function. Most evidence suggests, however, that water use function is non-linear. That is, a 1% cut would be proportionately easier to achieve than a 50% cut.
  
3. No adjustment is made for several critical factors, such as income or weather. These and a number of other factors could have caused significant changes in consumer behavior during the two study periods. Weather, for instance, might have had a larger impact than price changes did on the level of consumer consumption. If the price increase was coincident with cooler weather, then the resulting demand function would overestimate consumers' price elasticity. The reverse is also true. This critical defect in the model has resulted in "irrational responses" such as groups that increase their water uses in response to price increases.

4. The sample population is probably not representative of the customer population. The sample was limited to customers who received a penalty in September of -- 1991. Given that LADWP's overall conservation objective was met, then customers in the sample on average paid more and conserved less (in percentage terms) than the typical customer. Therefore, customers in the sample on average had a lower water price elasticity than the typical customer and a higher willingness to pay for water.
5. The size of the user groups for both residential and commercial users is not reflective of the service area customer population. For instance, customers that use under 9 units represent less than 0.1% of the single family residential sample population while those that use over 36 units represent over 50 percent of the sample.
6. The study assumed that all customers faced the same marginal rate for water. However, this clearly was not the case and the analysis overestimated the reaction of customers that had higher marginal costs and underestimated that of customers who faced a lower marginal cost.
7. The DMG study focuses on the first year in the first big California water shortage. It thus measures short-term responses to what most customers perceived as a short-term phenomena and temporary price changes. Over the longer-term, especially if there were frequent shortages, customers would probably respond differently.